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APPLICATION NUMBER: 60/427,533

FILING DATE: November 19, 2002

RELATED PCT APPLICATION NUMBER: PCT/US03/37188

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PROVISIONAL APPLICATION FOR PATENT COVER SHEET

This is a request for filing a PROVISIONAL APPLICATION FOR PATENT under 37 CFR 1.53(c)
Express Mail Label EV 169612291 US

| INVENTOR(S) | | | | |
|--|------------------|---------------------------|---|--|
| Given Name (first and middle [if any]) | | Family Name or Surname | Residence (City and either State or Foreign Country) | |
| Andrew R. Dennis J | | Barron Flood | Houston, Texas Oberlin, Ohio | |
| <input type="checkbox"/> Additional inventors are being named on the _____ separately numbered sheets attached hereto | | | | |
| TITLE OF THE INVENTION (280 characters max) | | | | |
| FABRICATION OF LIGHT EMITTING FILM COATED FULLERENES AND THEIR APPLICATION FOR IN-VIVO LIGHT EMISSION | | | | |
| Direct all correspondence to | | CORRESPONDENCE ADDRESS | | |
| <input checked="" type="checkbox"/> Customer Number | | 23505 | | |
| OR | | Type Customer Number here | | |
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| Country | | Telephone | FAX | |
| ENCLOSED APPLICATION PARTS (check all that apply) | | | | |
| <input checked="" type="checkbox"/> Specification | Number of Pages | 3 | <input type="checkbox"/> CD(s), Number | |
| <input type="checkbox"/> Drawing(s) | Number of Sheets | * | <input type="checkbox"/> Other (specify) | |
| <input checked="" type="checkbox"/> Application Data Sheet. See 37 CFR 1.76 | | | | |
| METHOD OF PAYMENT OF FILING FEES FOR THIS PROVISIONAL APPLICATION FOR PATENT | | | | |
| <input checked="" type="checkbox"/> Applicant claims small entity status. See 37 CFR 1.27. | | | FILING FEE | |
| <input type="checkbox"/> A check or money order is enclosed to cover the filing fees | | | AMOUNT (\$) | |
| <input checked="" type="checkbox"/> The Commissioner is hereby authorized to charge filing fees or credit any overpayment to Deposit Account Number: 03-2769 | | | \$80.00 | |
| <input type="checkbox"/> Payment by credit card. Form PTO-2038 is attached | | | | |
| The invention was made by an agency of the United States Government or under a contract with an agency of the United States Government. | | | | |
| <input checked="" type="checkbox"/> No | | | | |
| <input type="checkbox"/> Yes, the name of the U.S. Government agency and the Government contract number are: | | | | |

Respectfully submitted,

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Date November 19, 2002

REGISTRATION NO. 36,962

DOCKET NO. (if appropriate) 1789-09501

USE ONLY FOR FILING A PROVISIONAL APPLICATION FOR PATENT

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Application Data Sheet

APPLICATION INFORMATION

| | |
|--------------------------|--|
| Application Type:: | Provisional |
| Subject Matter:: | Utility |
| Title:: | FABRICATION OF LIGHT EMITTING FILM COATED FULLERENES AND THEIR APPLICATION FOR IN-VIVO LIGHT EMISSION |
| Attorney Docket Number:: | 1789-09501 |
| Small Entity?:: | Yes |

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Fabrication Of Light Emitting Film Coated Fullerenes And Their Application For In-Vivo Light Emission

The invention relates to the fabrication of thin films of various types of light emitting materials, including but not limited to photonic bandgap engineered materials, III-V and II-VI binary, ternary, and quaternary compound semiconductors, polymers, liquid crystals and certain classes of organic compounds, on the surface of fullerenes.

The films may be used as quantum coatings to provide stimulated emission (photoluminescence). If a non-spherical fullerene, such as C_{70} or a single wall or multiwall nanotube is employed, linearly polarized stimulated emission may be produced. The surface of the light emitting film may be functionalized to allow attachment to specific biological entities. Subsequent photoluminescence may be used to effect biological changes.

Fabrication of the light emitting film in the present invention is based on an invention disclosure made by Professor Andrew R. Barron to Rice University in June 2001. The Barron/Rice invention describes a conceptual approach for the fabrication of inorganic materials as thin films, coatings or composites. The fabrication takes place under mild conditions from solution.

A key step in the present process is initiating a uniform heterogeneous growth of the light emitting film directly on the activated surface of fullerenes; growth continues to a predetermined thickness established by the desired ratio of coated fullerene volume to the thickness of the light emitting film.

This invention uses a previously disclosed general concept for the growth of thin films, coatings and composites from solution under ambient or low temperature conditions. The general steps are provided below.

The invention is aimed at the creation of composition of matter consisting of a fullerene or carbon nanotube (or other inert chemically functionalized nanoparticle such as an alumoxane) coated by a light emitting thin film, see Figure.



A wide range of light emitting film nanoparticles have been grown by solution. These include: ZnS, CdS, CdSe, GaAs, InP, various polymers and organic compounds. A range of methods may be used to accomplish the film growth. However, it is important to functionalize the surface of the fullerene "seed" such that heterogeneous crystal film growth occurs.

In order to specifically coat the fullerenes, seed growth must be initiated on the surface of the fullerene. This is accomplished by partially hydroxylation of the surface of the fullerene, C_{60} .

The present invention uses multiple applications of the three basic steps of the Rice invention. The first application is to coat the fullerenes with light emitting films and involves: (1) the activation of the fullerene surface to promote heterogeneous growth; (2) the catalyzed growth of the desired material; (3) maintaining the growing surface as the most reactive component of the process to assure heterogeneous growth.

Applications for this invention include the following.

In vivo applications include, but are not limited to.

1. disabling or destroying foreign bodies in the blood and lymph systems such as parasites, bacteria, viruses and pathogenic proteins
2. physical alteration or destruction of specific biomolecular structures such as cholesterol deposits on the interior of veins and arteries, as well as intracellular pathogens
3. cauterization of blood vessels without the need for invasive surgical techniques;
4. photon-assisted wound healing
5. photon-assisted reconstruction of severed nerve tissue
6. site specific molecular identification for diagnostic purposes

Semiconductor quantum dots are known to emit light by photoluminescence, i.e., irradiation of the nanoparticle quantum dot by light of one frequency results in the emission of light at a different, lower frequency. However, the emitted light is not polarized. In order for polarized light to be emitted from the quantum dot, it must have an aspect ratio of 2:1 or more. By providing a "hollow" quantum dot that is oval or cylindrical in shape polarized emission is anticipated. Depending on the location of a reflecting layer, the quantum dot may be thought of also act as a quantum laser. It is anticipated that similar properties will obtain for thin film layers of other light emitting materials deposited on fullerenes.

The fabrication of specific oval quantum dots may be accomplished by the solution growth of the light emitting film on a surface pre-form. However, this pre-form must be on the sub nanometer scale. In order to accomplish this achievement we propose to employ functionalized carbon fullerenes and nanotubes as pre-forms.

There are several new technologies in development in which nanoparticles or nanoshells are functionalized with biological receptor molecules. The concept is that these nanoparticles and shells will be irradiated in-vivo to generate significant localized heating. The heating is to be used to kill cells such as cancer cells. However, heating in-vivo could lead to secondary issues.

One of the applications of the present technology is to functionalize the hollow light emitting film quantum dot "shells" such that they emit polarized light in-vivo to allow for localized destruction of undesirable species within the body. An example will be the removal of plaque or cholesterol from inside arteries.

We believe this approach is useful for the following reasons: 1) the possibility will exist to localize treatment to specific biomolecular structures, thereby eliminating unwanted side effects that always occur with non-discriminating therapies; 2) the wavelength of the emitted light can

be selected for maximum effectiveness by the choice of light emitting film and quantum layer deposition parameters; 3) therapy can be administered either by direct injection of the nanoparticle light sources into targeted structures, or intravenously, as conditions dictate.

It is sometimes desirable to introduce non-invasive light emitting structures in vivo for therapeutic or diagnostic purposes. One of ordinary skill in the art will understand the need to assure that there are no undesirable chemical interactions between the light emitting layer and the in vivo environment.

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